

CLAIMS:

1. A process for the production of ethyl acetate which comprises:

(a) converting a C₂ feedstock comprising ethanol to ethyl acetate in an ethyl acetate production zone by a procedure selected from:

- (i) dehydrogenation,
- (ii) oxidation,
- (iii) reaction with acetaldehyde, and
- (iv) oxidation to acetaldehyde followed by the Tischenko reaction;

(b) recovering from the ethyl acetate production zone an intermediate reaction product mixture comprising hydrogen and liquefiable products comprising ethyl acetate, ethanol, and by-products containing reactive carbonyl groups;

(c) contacting at least a portion of the liquefiable products of the intermediate reaction product mixture with a selective hydrogenation catalyst in the presence of hydrogen in a selective hydrogenation zone maintained under selective hydrogenation conditions effective for selective hydrogenation of by-products containing reactive carbonyl groups thereby to hydrogenate said by-products selectively to hydrogenated by-products comprising corresponding alcohols;

(d) recovering from the selective hydrogenation zone a selectively hydrogenated reaction product mixture comprising ethyl acetate, ethanol, hydrogen and hydrogenated by-products;

(e) distilling material of the selectively hydrogenated reaction product mixture in one or more distillation zones so as to produce a first composition comprising substantially pure ethyl acetate and a second composition comprising ethanol and water;

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Sub B2 (f) treating the second composition of step (e) to separate water therefrom and yield a third composition comprising ethanol with a reduced water content; and (g) recovering the third composition of step (f).

5 2. A process according to claim 1, wherein in step (a) the C₂ feedstock is converted to ethyl acetate by a dehydrogenation procedure which comprises contacting a vaporous mixture containing ethanol and hydrogen with a dehydrogenation catalyst in a dehydrogenation zone
10 maintained under dehydrogenation conditions effective for dehydrogenation of ethanol to yield ethyl acetate.

Sub B3 3. A process according to claim 2, wherein the dehydrogenation conditions include use of an ethanol:hydrogen molar ratio of from about 1:10 to about
15 1000:1, a combined partial pressure of ethanol and hydrogen of from about 3 bar (3×10^5 Pa) up to about 50 bar (5×10^6 Pa), and a temperature in the range of from about 100°C to about 260°C.

Sub B4 4. A process according to claim 3, wherein the dehydrogenation conditions include use of a combined partial pressure of ethanol and hydrogen of at least about 6 bar (6×10^5 Pa) up to about 30 bar (3×10^6 Pa).

Sub A' 25 5. A process according to any one of claims 2 to 4, in which the dehydrogenation catalyst is a copper containing catalyst which comprises, before reduction, copper oxide on alumina.

6. A process according to any one of claims 2 to 5, in which the rate of supply of the C₂ feedstock to the dehydrogenation zone corresponds to an ethanol liquid hourly
30 space velocity (LHSV) of from about 0.5 hr⁻¹ to about 1.0 hr⁻¹.

7. A process according to any one of claims 1 to 6 in which the selective hydrogenation conditions of step (c)

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include use of a reaction product mixture:hydrogen molar ratio of from about 1000:1 to about 1:1, a combined partial pressure of the liquefiable products of the intermediate reaction product mixture and hydrogen of from about 5 bar (5×10^5 Pa) to about 80 bar (8×10^6 Pa), and a temperature in the range of from about 20°C to about 160°C.

10 8. A process according to any one of claims 1 to 7, in which the combined partial pressure of the liquefiable products of the intermediate reaction product mixture and hydrogen in step (c) is from about 25 bar (2.5×10^6 Pa) to about 50 bar (5×10^6 Pa).

15 9. A process according to any one of claims 1 to 8, in which the selective hydrogenation catalyst comprises a metal selected from nickel, palladium, platinum, ruthenium, rhodium and rhenium.

10 10. A process according to claim 9, in which the catalyst comprises ruthenium on carbon.

20 11. A process according to any one of claims 1 to 10, in which the rate of supply of liquefiable liquid products of the intermediate reaction product mixture to the selective hydrogenation zone corresponds to a liquid hourly space velocity (LHSV) of from about 0.5 hr^{-1} to about 2.0 hr^{-1} .

25 12. A process according to any one of claims 1 to 11, in which step (e) comprises supplying material of the selectively hydrogenated reaction product mixture to a first distillation zone maintained under distillation conditions effective for distillation therefrom of a first distillate comprising ethanol, water and ethyl acetate,
30 recovering a first distillate comprising ethanol, water and ethyl acetate from the first distillation zone and a bottom product comprising ethanol and water, supplying material of the first distillate to a second distillation zone maintained under distillation conditions effective
35 for distillation

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therefrom of a second distillate comprising ethanol, water, and ethyl acetate and so as to yield a substantially pure ethyl acetate bottom product, and recovering a substantially pure ethyl acetate bottom product from the second distillation zone.

13. A process according to claim 12, in which the first distillation zone is operated at a pressure of less than about 4 bar (4×10^5 Pa).

14. A process according to claim 12 or claim 13, in which the first distillation zone is operated at a pressure of from about 1 bar (10^5 Pa) to about 2 bar (2×10^5 Pa).

15. A process according to any one of claims 12 to 14, in which the second distillation zone is operated at a pressure of from about 4 bar (4×10^5 Pa) to about 25 bar (2.5×10^6 Pa).

16. A process according to any one of claims 12 to 15, in which the second distillation zone is operated at a pressure of from about 9 bar (9×10^5 Pa) to about 15 bar (1.5×10^6 Pa).

17. A process according to any one of claims 12 to 16, in which the first distillate contains less than about 10 mol % water.

18. A process according to any one of claims 12 to 17, in which an ethanol rich stream containing substantially all of the water in the selectively hydrogenated reaction product mixture is recovered from the bottom of the first distillation zone, while an overhead stream that contains "light" components present in the selectively hydrogenated reaction product mixture is recovered from the first distillation zone, and in which the first distillate comprises a liquid draw stream which is recovered from an upper region of the first distillation zone and which comprises ethyl acetate, ethanol, water and minor amounts of

other components.

19. A process according to claim 18, in which the liquid draw stream contains from about 40 mol % to about 55 mol % ethyl acetate, from about 1 mol % to about 6 mol % water, not more than about 1 mol % other components, and the balance ethanol.

20. A process according to claim 19, in which the liquid draw stream contains about 45 mol % ethyl acetate, about 50 mol % ethanol, about 4 mol % water and about 1 mol % other components.

21. A process according to any one of claims 18 to 20, in which the liquid draw stream is passed to the second distillation zone which is operated at a pressure of from about 4 bar (4×10^5 bar) absolute to about 25 bar (2.5×10^6 Pa) absolute.

22. A process according to claim 21, in which the bottom product from the second distillation zone contains from about 99.8 mol % to about 99.95 mol % ethyl acetate.

23. A process according to any one of claims 20 to 22, in which the second distillate comprises the overhead stream from the second distillation zone and is returned to the first distillation zone.

24. A process according to claim 23, in which the overhead stream from the second distillation zone contains about 25 mol % ethyl acetate, about 68 mol % ethanol, about 6 mol % water, and about 1 mol % of other components.

25. A process according to claim 23 or claim 24, in which the overhead stream from the second distillation zone is returned to the first distillation zone at a point above the feed point of the liquefiable products of the selectively hydrogenated reaction product mixture.

26. A process according to any one of claims 18 to 25, in which in step (f) the ethanol rich stream recovered from the

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bottom of the first distillation zone is subjected to treatment for the removal of water therefrom thereby to produce a relatively dry ethanol stream suitable for recycle to step (a).

5 27. A process according to any one of claims 1 to 26, in which the relatively dry ethanol stream of step (f) is recycled to step (a).

28. A process according to any one of claims 1 to 12, in which step (e) comprises extractive distillation with an
10 extractive agent comprising polyethylene glycol and dipropylene glycol, diethylene glycol, or triethylene glycol.

29. A process according to any one of claims 1 to 12, in which step (e) comprises extractive distillation in the
15 presence of an extractive agent containing dimethyl sulphoxide.

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